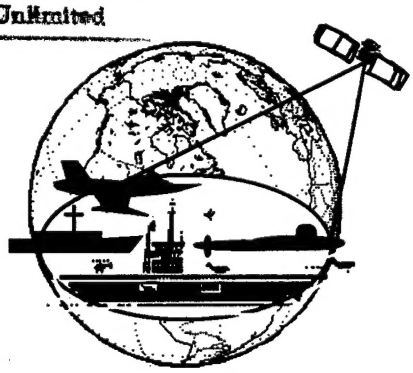
NAVY COOPERATIVE ENGAGEMENT ARCHITECTURE

WORKING GROUP FINAL REPORT

EXECUTIVE SUMMARY

WSA&E
WARFARE SYSTEMS ARCHITECTURE & ENGINEERING
SPAWAR 30



JUNE 1991

SPACE AND NAVAL WARFARE SYSTEMS COMMAND

EXECUTIVE SUMMARY

ES.1 INTRODUCTION

In recent years it has become increasingly obvious that no single sensor or weapon, acting alone or even in a coordinated effort with others, will be sufficient to deal effectively with the emerging threat potential of the late Twentieth and early Twenty-first Century. This is true in all Warfare Mission Areas, but particularly when addressing the potential Anti-Air Warfare and Anti-Submarine Warfare threats of a major world power. It appears to be equally true for encounters with Third World countries in Low Intensity Conflict/Contingency and Limited Objective Warfare, anti-terrorist and anti-drug operations. During the past ten years a small number of efforts have been initiated to address these issues through a concept loosely termed Cooperative Engagement .

While the genesis of the term Cooperative Engagement is somewhat obscure, it is most likely attributable to the Aegis Battle Group Anti-Air Warfare Coordination concept developed in the late 1970's. The concept has been expanded upon in the intervening years through various efforts, including that of the Advanced Airborne Anti-Air Warfare Engagement System working group in 1989, continuing initiatives in the Battle Group Anti-Air Warfare Coordination program, and the current Cooperative Engagement working group.

One might well ask, why cooperative engagement? The answer to that question is directly related to the estimated threat in the Twenty-first Century. The threat in terms of sophistication, diversity, and number of potential adversaries makes it imperative for U.S. Forces to look toward innovative ways to leverage basic capabilities, both now and in the future. The cooperative engagement initiative is an attempt to overcome stand-alone sensor and weapon system limitations, especially when targets employ both flight profile and multi-spectral stealth measures of signature control. Moreover, changing technologies and emerging third-world capabilities present reduced response times, implying the need for a realtime surveillance and response capability available to the force at all times.

In November of 1989, the Warfare Systems Architecture Directorate of the Space and Naval Warfare Systems Command was tasked by ASN (R,E, & S) through OP-98 and OP-07 to develop a high level architecture for Cooperative Engagement and a more detailed functional architecture for Anti-Air Warfare Cooperative Engagement. Additional tasking included an identification of technologies, demonstrations, and other initiatives that would be required to meet the Navy's long range goals for Cooperative Engagement system engineering, including a review of current and planned cooperative engagement programs and efforts. This initiative had its genesis in a perceived need for the Navy to develop a conceptual Cooperative Engagement architecture to guide current and future program definition in order to reduce the

risk of fielding individual systems which might collectively miss the mark in both function and performance.

Under the guidance of the Director for Warfare Systems Architecture, a Task Force was commissioned in November 1989. To pursue this effort, a multi-laboratory team was established to initially develop a top-down perspective that was unencumbered by programmatics. Following the overall top-down look, a detailed functional Anti-Air Warfare architecture was developed, including those elements of physical and organizational development necessary to fully flesh out the concept.

This report represents the results of that multi-laboratory team working group effort. Volume One presents the final report of the working group and is intended to provide a stand-alone response to the original tasking. Volumes Two and Three contain Appendices.

ES.2 SCOPE, LIMITATIONS, AND METHODOLOGY

It was not the intent of this effort to make a case for Cooperative Engagement. It was rather an effort to create a framework or architecture so that one can see how all of the pieces fit together. It was also not the intent to assess or quantify the value of Cooperative Engagement but to qualitatively review the Cooperative Engagement concept. It was certainly not intended that this effort assess the health or performance of existing programs. However, an evaluation matrix has been developed which can be used in evaluating the contributions of various programs and developmental efforts.

Analysis was conducted within the context of seven parameters; time horizon, warfare areas, warfighting media, battle space, size of the fighting force, level of architecture detail, and performance assessment. Both the conceptual and detailed Anti-Air Warfare architectures reflect the 2020+ time frame. The conceptual architecture is intended to provide a high level framework which could be adapted to other warfare mission areas. The reference point for the Anti-Air Warfare Cooperative Engagement Architecture is the Anti-Air Warfare Current Plus Architecture of 31 March, 1989.

Cooperative Engagement is defined as a warfighting capability designed to defeat threats through the synergistic integration of distributed resources among two or more units. Cooperative Engagement has the purpose of fighting the force and its systems as an entity, just as we now fight individual platforms.

It was determined in the early stages of this effort that products must be both pragmatic and directly related to other on-going efforts. As this effort was to be extended to Anti-Air Warfare, the Carrier Battle Force was selected for assessment. As far as was possible, however, other battle force compositions as well as supporting mission areas were considered during development of the conceptual architecture.

Essential to the analysis was the development of potential example threats which could be utilized for both the derivation of required functions and the

assessment of candidate configurations. It should be noted that these threat examples are just that. They depict possible threat configurations and are not intended to reflect actual anticipated threat scenarios. Examples used in this analysis are as follows:

- Low Slow Reduced Observable Cruise Missile
- Outer Air Battle
- Fast High Flyer
- Fast Sea Skimmer
- Drug Interdiction

The first four examples were selected as they provide a broad range of potential threats. The fifth, Drug Interdiction was selected due to its communications, command and control, and sensor correlation requirements. Appendix F contains a complete description of these five threat examples.

ES.3 CONCEPTUAL CE ARCHITECTURE

In the broadest sense, a conventional engagement is limited to resources available on the engaging platform. Engagement range is constrained as is depth of fire and firepower. Using the basic functions of detect - control - engage, we see that the control and engage function are almost always accomplished by the shooter. If it were possible to share these functions among other platforms in the force, these constraints could be eliminated.

The key concepts of Cooperative Engagement are as follows:

- Fight the force as a "whole"
- Implement the full range of functionality available on one platform across multiple platforms
- Manage signature control, sensor and resource tasking, and weapons distribution at the Force level
- Achieve optimal pairing of platforms for engagement
- Improve multi-dimensional and multi-source sensing
- Decentralize
- Provide end-to-end data communications from sensor to weapon

The conceptual Cooperative Engagement architecture is comprised of seven tier 1, 25 tier 2, and 95 tier 3 functions. These provide the granularity needed to extend the conceptual architecture to virtually any of the warfare mission areas.

Several issues were apparent during the development of the conceptual architecture. These include:

- Force-wide connectivity (virtual network)
- Network topology
- Fusion
- Maintenance of the tactical picture
- Battle management
- Battle force organization and delegation of authority

ES.4 ANTI-AIR WARFARE COOPERATIVE ENGAGEMENT ARCHITECTURE

The Anti-Air Warfare Cooperative Engagement architecture was developed from the existing Anti-Air Warfare Current Plus architecture. It recognizes that greater threat ranges, more sophisticated delivery platforms, expanded weapons varieties and envelopes, as well as observability reduction techniques through accommodation of new or revised functions, necessitate changes in design. New or revised operational concepts require expansion of the battle space, a more capable and flexible communications system, more accurate position determination across all platforms, and improved data correlation and fusion.

This effort recognizes that more than one solution to the Anti-Air Warfare Cooperative Engagement problem is possible, given differing levels of threat and investment. For that reason, nine potential configurations, or cases were developed. These reflect different levels of capability towards a full satisfaction of all functions at the required level. These capabilities are shown in Figure ES-1 and further described in Appendix G.

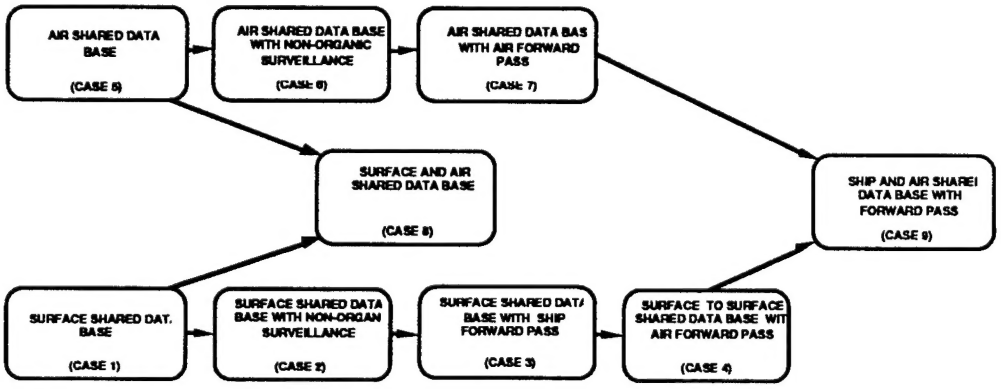


Figure ES-1. Cooperative Engagement Cases

ES.5 ANALYSIS AND EVALUATION

Two of the Anti-Air Warfare potential configurations (cases) were subjected to analysis during this effort. These were Case 2 - Surface Shared Data Base Augmented by Air Surveillance and Case 5 - Air to Air Data Base.

For the Case 2 analysis it was assumed that air and surface platforms had compatible sensors and that data networks were in place. It was also assumed that weapons had autonomous guidance capability. Analysis indicated that the Case 2 configuration does expand the battle space and allow engagement beyond the launching ship's horizon. It also provides hard kill capability were none existed, increases depth of fire, and improves crossing fire capability.

For the Case 5 analysis it was assumed that air and surface platforms had compatible sensors and that data networks were in place. It was also assumed that Advanced Air-to-Air Missile with autonomous control was available and that the air platform was capable of launch and weapon update on remote track. Analysis indicated that the Case 5 configuration extended the launch platforms electromagnetic horizon, provided significant increase in warfighting performance, and enabled engagement to kinematic limits of weapons.,

ES.6 CONCLUSIONS AND RECOMMENDATIONS

It was concluded that Cooperative Engagement, as reflected in the Cooperative Engagement architecture, can result in significant improvement in warfighting capability.

The following specific recommendations for Anti-Air Warfare are provided:

- Support Data Distribution System/Cooperative Engagement Processor
- Define a Cooperative Engagement Program for the Air Community
- Initiate the Tentative Operational Requirement/Development Options Proposal process for Cases 2 and 5
- Leverage future opportunities through the Master Planning Process

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